(54) Title: SYSTEM AND METHOD FOR SIMULATING THE BEHAVIOUR OF A NETWORK FOR MOBILE RADIO APPA-
RATUS

(57) Abstract: The present invention is related to a system for simulating the behaviour of a telecommunications network for mobile
radio apparatuses and to the relating method. The system comprises an integrated simulation environment (30) having a modular
structure based on interchangeable objects, that comprise a simulation engine (31) and a plurality of devices (34) representative of
apparatuses as well as physical elements of the network. By virtue of its structure based on objects which are interchangeable and
capable of being selectively activated, the system allows the simulation of networks for high complexity mobile radio apparatuses in
terms of quantity of apparatuses and type of systems or networks. The system is easily expansible as a function of both the variation
of the system or network types and the technological implementations available on the market.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

UZ, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

— of inventorship (Rule 4.17(iv)) for US only

Declarations under Rule 4.17:
- — as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG,

Published:
- — with international search report
- — before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

SYSTEM AND METHOD FOR SIMULATING THE BEHAVIOUR OF A NETWORK FOR MOBILE RADIO APPARATUSES

Technical Field

The present invention is related to a system for
5 simulating the behaviour of a telecommunications network for mobile radio apparatuses or cellular telephones and to the relating method of simulating the behaviour of this type of networks.

In particular the present invention is related to a system in
10 which it is possible by means of a computer to check beforehand the behaviour of the network with respect to the different scenarios defined from time to time and without the need of performing field trials.

Background Art

15 As is well known, with the evolution of telecommunications, networks for cellular phones become more and more complex, and consequently it becomes more difficult to verify the behaviour of such networks, taking into account the various possible scenarios, represented for instance by
20 the number and type of apparatuses being used, typology of available services and time distribution of such services.

It is also known that with the evolution of telecommunications various types of systems for cellular telephones are available on the market, such as the GSM
25 (Global System for Mobile Communications), GPRS (General Packet Radio Service) system and the UMTS (Universal Mobile Telecommunications System), and different technological implementations, such as those represented by apparatuses of different manufacturers, and that, therefore, the choice
30 among various alternatives of scenarios which as such is already difficult for a same type of network, becomes even more complex if it is to be made taking into account different systems and different technological solutions.

The evaluation of complex scenarios and the choice among
35 alternatives of different systems and technologies have always been faced by the present art in a partial way, that is through simulation environments (simulators) either lacking of modularity or applicable to contexts of limited

complexity only or applicable to only a typology of system or technology.

For instance, general purpose simulators are known which, even if theoretically capable of simulating different

5   networks, have on the other hand the strong limitation of not being able to simulate networks characterised by a high complexity in terms of quantity of apparatuses, because, due to their architectural structure, they cannot be practically used in such contexts.

10   As a matter of fact, owing to the definition modalities of the network scenario to be simulated, usually performed through uncompiled files (i.e. files that have to be interpreted by the system), general-purpose simulators require exponentially increasing simulation times as a

15   function of the network complexity in terms of number of apparatuses.

There are known as well simulators of "custom" type, developed for instance by research establishments, which are capable of simulating complex networks in terms of number of

20   apparatuses, however structured with specifically optimised architectures for the simulation of problems or specific systems or specific technologies of a particular manufacturer, and therefore they cannot be used for the simulation of different networks of different technology.

25   In essence, the instruments known so far are inadequate to meet the twofold requirement of simulating complex networks in terms of quantity of apparatuses and network type, and of comparing, through simulation, the behaviour of such networks within the different technological contexts as

30   a function of the services being offered.
As a matter of fact, the instruments available so far meet, to a limited extent only, one of the two requirements above, thus making only partially possible the use of the same simulators and requiring from time to time to resort to field

35   measurements for result accuracy check or to use a plurality of simulators
for the analysis of the various operation characteristics of the networks as the possible situations vary.

3

Disclosure of the Invention

The technical problem the present invention aims to face and solve, is that of implementing a unique simulator for cellular telephone networks which by virtue of an appropriate type of architecture and of an innovative approach in the management of the different possible scenarios, allows simulating and comparing various networks characterised by a different complexity and a different technology with extremely short processing times.

Such a technical problem is solved by the system and by the method having the characteristics specifically described in the appended claims.

In particular, according to a characteristic of the present invention, the system has a modular structure based on interchangeable objects and capable of simulating high complexity networks in terms of quantity of apparatuses.

Furthermore, the system may be used for simulating different protocol layers and is easily expandable as a function of the types of cellular telephone systems and of the technological implementations available on the market. Moreover, the system allows the simulation of networks where different cellular telephone systems are operating, such as GSM, GPRS and/or UMTS, and/or different technological implementations, and an easy comparison of their performance.

Brief Description of Drawings

This and other characteristics of the present invention will become evident from the following description of a preferred embodiment, given by way of a non-limiting example through the attached drawings, wherein:

Figure 1 depicts a processing system for simulating the behaviour of a network for mobile radio apparatuses according to the invention;

Figure 2 shows the architecture of the simulation environment according to the invention;

Figures 3 and 4 show, according to a symbology of UML (Unified Modelling Language) type, classes of devices incorporated in the architecture of Figure 2; and

Figure 5 depicts a flow chart of the method according to the invention.

Best mode for Carrying Out the Invention

With reference to Figure 1, a processing system for
5 simulating the behaviour of a network of mobile radio
telecommunications apparatuses comprises for instance a Work
Station 10, of a known type, having a processing sub-system
(basic module) 11, a display 12, a keyboard 15, a mouse 16
and a device 19 for the connection to the local network.
10 Work Station 10, for example the J5000 model by Hewlett-
Packard equipped with a 450 MHz CPU, a 1GByte-RAM, a 18Gbyte-
Disk Unit (HD) and operating system of UNIX type, is capable
of processing sets of programs or modules and of displaying
the results on the display 12, as will be described later in
15 detail with reference to the method according to the present
invention.

The system according to this invention further comprises
a disk-subsystem, 20, of a known type, linked through a net
connection 19 to Work Station 10 and capable of containing,
20 adequately stored, computer modules that are implemented for
performing the method according to the present invention, and
reference data banks, as will be described in detail in the
sequel. Obviously, data banks and modules may also be stored,
if of a limited size, into the HD of Work Station 10, without
25 changing the characteristics of the invention.

In the herein described configuration, the system is such
as to allow the simulation of a mobile radio network through
configuration parameters 35 (Figures 1 and 2), which are
capable of defining a particular scenario to be simulated,
30 and a simulation environment (simulator) 30, that can process
and generate its output data representative of the results of
the performed simulation (output data) 37, as will be later
described in detail.

The simulator 30, developed for instance in the
35 programming language C++ and through a design platform UML
(Unified Modelling Language), of a known type, incorporates,
according to an approach by objects, a simulator engine 31,
formed by classes and modules that allow managing and

organising the simulation, and a plurality of package devices, 34, formed by classes and modules, relating to both individual physical devices of the telecommunications network to be simulated, such as, for instance, mobile terminals or radio base-stations, and physical elements of the network, such as, for instance, radio-link paths.

According to the present example of embodiment, engine 31 is able to control and manage the simulation and comprises a set of processing modules which can be activated from time to time as a function of the specific simulation requirements. Said modules are, for instance, a parameter manager 31a, an event scheduler 31b, a memory or factory manager 31c, and a statistic manager, 31d, and are all described in a known programming language, such as the C++ language, and according to an approach by objects.

Parameter manager 31a is a processing module capable of reading the configuration parameters (input data) 35, gathered for instance in a data file and stored in the internal disk unit of Work Station 10, and of organising in the RAM of the same Work Station, 10, the parameters that have been read.

Thus, parameter manager 31a is capable of initialising the simulation, making available to the various devices to be simulated, the parameters read from the input data 35.

Event scheduler 31b is a processing module capable of scheduling asynchronous events, typical of a telecommunications network, such as for instance telephone calls, data transfer requests, and so on.

In particular, such event scheduler 31b performs the queuing of the events as they are generated by the various devices, and the extraction of the same events, duly sorted according to the defined scheduling (timestamp).

For instance, for each extracted event, event scheduler 31a performs the following operations, namely:

- it sets the present time of the simulation on the event timestamp,

- it carries out the event invoking the destination device of the event;

- it provides the extraction of an additional event.

Event scheduler 31b acts in the way described above until either a simulation time limit predefined within the scenario is reached or there are no longer events to be extracted.

In essence, on the basis of the above description, event scheduler 31b is capable of simulating by successive steps the time evolution of a telecommunications network for mobile radio apparatuses.

Factory manager 31c is a processing module capable of optimising the allocation of objects to be simulated 34, in the RAM of Work Station 10.

In particular, factory manager 31c co-operates with event scheduler 31b so as to hold in the memory for a determined period and for the purpose of a possible re-use, the events already used by event scheduler 31b.

Statistic manager 31d is a processing module capable of gathering and processing statistics in a centralised manner, on the basis of data collected through the various devices 34 during the simulation.

In particular, statistic manager 31d is capable of extracting data from the objects configured or allocated in the RAM of Work Station 10, and of storing and/or processing them in order to provide in output the output data 37 corresponding to the simulation result.

For instance, statistic manager 31d is capable of processing the data corresponding to the events being simulated and of providing them on its output as output data 37 in the form of information to be visualised on display 12 of Work Station 10 or of a file to be printed.

Package device 34 (Figures 2, 3, and 4) comprises devices representative of physical devices of the network, such as mobile radio stations or MS 41, radio base stations or BTS 51;

control stations or BSC, SGSNs(Serving GPRS Support Node), GGSNs (Gateway GPRS Support Node) and HOST stations, and objects relating to the scenario to be simulated, such as for

instance type of territory, typology and location of buildings, traffic density, and so on, all described in a programming language of a known type, for instance, in C+++ and according to an approach by objects.

5   Hereafter there are described and depicted in Figures 3 and 4, respectively, and by way of an example, the devices MS 41 and BTS 51, keeping in mind that the additional devices which form the network for mobile radio apparatuses and are not shown, can be generated and simulated in a way similar to

10   what is described in the sequel.

The generic device MS 41 comprises, according to the present example of embodiment, a module for a mobility management (Mobility module) 40, a class representative of the device "terminal of GSM type" so.configured as to emulate

15   the behaviour specific of a cellular telephone (mobile radio terminal or mobile terminal) of GSM type (device GSM_MS) 41a and a class representative of the device "terminal of GPRS type", configured to emulate the behaviour specific of a cellular phone of GPRS type (device GPRS_MS) 41b.

20   Mobility module 40 is capable of managing the events relating to the mobility, i.e. is capable of simulating the displacement of the mobile, causing the variation of the positioning coordinates of the same as a function, for instance, of appropriate parameters being part of the input

25   data 35.

Device GSM_MS, 41a comprises modules representative of protocol layers managed by such a device.
In particular, device GSM_MS 41a comprises modules representative of the protocol of physical layer (GSM_ms_PHY)

30   42A, able to simulate the transfer of information, for instance, on a Time Slot (TS) at a time, a module representative of the RR protocol layer (GSM_ms_rr) 43a and a module representative of the application layer protocol or a voice traffic generator module (GSM_MS_VCG) 49a, as will be

35   described in detail, making reference to Figure 3, denoted by the UML symbology of known type.

8

The GSM_MS_PHY module 42a can implement the physical layer functionalities of the GSM mobile terminal according to the specifications of the GSM Standard.

For instance, module GSM_MS_PHY 42a is capable of simulating
5   the transmission of electromagnetic signals from the mobile terminal to the Radio Base Station through events that comprise, for instance:

- transmitted power level,

- transmission frequency used

10   - time slots used, etc.

Module GSM_MS_RR 43a is capable of simulating the funcionalities foreseen by the RR layer of the GSM protocol which corresponds to the management of the radio resource, according to the GSM specification of known type.

15   For instance, module GSM_MS_RR, 43a, is able to exchange information with the lower and higher layers of the GSM protocol, as described in the specification.

Module GSM_MS_VCG, 49a, is capable of simulating the calls the mobile terminal has to effect.

20   In particular, module GSM_MS_VCG, 49a, is capable of producing voice calls with a duration depending upon appropriate parameters defined in the input data 35; for example, module GSM_MS_VCG 49a, is capable of simulating voice calls of a duration which is variable and dependent on
25   an average duration value, defined in the input data 35.

Device GPRS_MS, 41b, comprises likewise modules representative of the protocol layers managed by such type of device.

In particular the above-cited GPRS_MS device 41b
30   incorporates: a module representative of the physical layer protocol (GPRS_MS_PHY) 42b, able to operate, for instance, on a maximum of 8 TS at a time; modules representative of the RR protocol layers (GPRS_MS_RR) 43b, of RLC/MAC layer (GPRS_MS_RLCMAC) 44b, of LLC layer (GPRS_MS_LLC) 45b, of
35   SNDCP layer (GPRS_MS_SNDCP) 46b, of NL layer (GPRS_MS_NL) 47b, and of application layer APPLICATION (GPRS_MS_APP) 48b, and data traffic generator (GPRS_MS_PCG) 49b, respectively,

as will be described in detail in the sequel, with reference to Figure 3, with notations in the UML symbology of known type.

Module GPRS_MS_PHY module, 42b, is capable of implementing the physical layer of the protocol of the GPRS mobile terminal. In particular, Module GPRS_MS_PHY 42b is capable of simulating the following functionalities:

- power level control of the mobile;
- access to common/dedicated radio resources;
- usage of assigned Time Slots (TS);
- interference measurements.

Module GPRS_MS_RR 43b is capable of implementing the access to circuit radio resources, assigned to the mobile terminal on the basis of input data 35 or of configuration data.

Module GPRS_MS_RLCMAC 44b is capable of implementing the RLC (Radio Link Control) layer and "MAC" (Medium Access Control) layer for simulating the data transmission/reception in the "packet mode" through radio resources.

In particular, module GPRS_MS_RLCMAC 44b is capable of simulating all the functionalities covered by the GPRS Standard, such as for instance:

- dynamic seizure of radio channels;
- usage of an individual time slot in multiplexing or sharing with other mobile terminals;
- control of transmission errors through ARQ (Automatic Repeat reQuest) technique;
- release of a radio channel in favour of an incoming voice call;
- simultaneous use of more channels.

Module GPRS_MS_LLC, 45b, is capable of implementing the "LLC" (Logical Link Control).layer.

In particular, module GPRS_MS_LLC 45b is capable of simulating the reception of data packets from the higher layer (SNDCP protocol), the segmentation or splitting of the same data packets, and the transfer (delivery) to the lower layer (RLCMAC protocol) or viceversa.

Module GPRS_MS_SNDCP 46b, is capable of implementing protocol layer "SNDCP" (Sub-Network Dependent Convergence Protocol).

In particular, module GPRS_MS_SNDCP 46b is capable of
5   simulating the segmentation of data packets coming from the higher layer "NL" and the transfer to the lower layer of protocol "LLC", and viceversa.

The GPRS_MS_NL module, 47b is capable of implementing protocol layer "NL" (Network Layer) of the GPRS terminal.
10   In particular, GPRS_MS_NL module 47b is capable of simulating the following functionalities:

- reception of data packets from the "APP" layer;
- segmentation or organisation of data into data packets of smaller sizes (new data packets);
15   - addition to the new packets of a header containing information on how to reassemble the initial packets;
- transfer of the new data packets to the lower layer "NSDCP", or

the inverse functionalities for data packets coming from the
20   lower layer "SNDCP".

Module GPRS_MS_APP, 48b, is capable of implementing the Application layer" of the GPRS terminal.

Module GPRS_MS_PCG 49b is capable of implementing the functionality of generation of data packets of different
25   sizes, in terms of number of bit, and of a determined repeatability following the time distribution of generation.

In particular, module GPRS_MS_PCG 49b is capable of simulating in a statistical way, on the basis of input data 35, the data traffic of the GPRS terminal.

30   As will be explained in detail, by virtue of the object architecture, device MS 41, as a function of appropriate input data 35, is capable of simulating, according to one of the characteristics of the present invention, the behaviour of cellular phones within networks of GSM type, GPRS type or
35   of a mixed type.

Obviously, as will become apparent to those skilled in the art, the above described architecture, being modular, can be extended through the introduction of additional types of

MS device, such as for instance MS devices of UMTS type, or of other types of devices, and therefore it easily allows the integrated simulation of different types of systems for mobile radio apparatuses.

5   The generic device BTS 51, incorporates, according to the present example of embodiment, modules representative of protocol layers managed by such type of device.

In particular, device BTS 51 comprises modules representative of the physical layer protocols (BTS_PHY) 50, of the RRM

10   layer protocols (BTS_RRM module) 53, of the CCHRR layer protocols (CCH_BTS_RR module) 53a, of the PCCHRR layer protocols (PCCH_RR module), 53b, of the RLCMAC layer protocols, GPRS_BTS_RLCMAC module 54b, and GPRS_BTS_RLCMAC_Manager 55b, respectively, of the RR layer

15   protocols, module GSM_BTS_RR 54a, and module GSM_BTS_RR_manager 55a, respectively, and of the RRM protocol layers (BTS_RRM module) 53, as will be described in detail in the sequel, making reference to Figure 4 denoted in UML symbology of known type.

20   Module BTS_PHY 50, is capable of implementing the protocol layer PHY (PHYsical Layer) of BTS.

In particular, module BTS_PHY 50 is capable of simulating the following functions:

- power level control of BTS;

25   - access to common or dedicated channels for services on a circuit basis.

      Module CCH_BTS_RR 53a, is capable of implementing the CCHRR (Common CHannel Radio Resource) protocol layer of the BTS corresponding to the management of the access to the

30   radio resource of the common channel for circuit switched services.

      Module PCCH_BTS_RR 53b, is capable of implementing the PCCHRR (Packet Common CHannel Radio Resource) protocol layer of the BTS corresponding to the management of the access to

35   the radio resource of the channels for "packet" services.

      Module GPRS_BTS_RLCMAC 54b is capable of implementing the RLCMAC (Radio Link Control/Medium Access Control) protocol layer of the BTS.

In particular, module GPRS_BTS_RLCMAC 54b is capable of simulating the access to the packet radio resources by a user and the re-transmission of wrong data received.

According to a characteristic of the present invention,
5 during the simulation the object module corresponding to module GPRS_BTS_RLCMAC 54b is allocated into the memory of Work Station 10 (Figure 1) in a number equal to the GPRS users being active at a given instant of the simulation (Figures 1, 2 and 3).

10   Module GPRS_BTS_RLCMAC_Manager 55b is capable of managing the allocation into and the release (de-allocation from the memory) of the various GPRS_BTS_RLCMAC 54b corresponding to the active GPRS users.

Module GSM_BTS_RR 54a is capable of implementing the RR
15 (Radio Resource) protocol layer of the BTS.

In particular, module GSM_BTS_RR 54a is capable of simulating the access to circuit switched radio resources by a user.

According to a characteristic of the present invention, during the simulation, the object module corresponding to
20 module GSM_BTS_RR 54a is allocated into the memory of the Work Station in a number equal to the GSM users being active in a cell at a given instant of the simulation (Figures 2, 3, and 4).

Module GSM_BTS_RR_Manager 55a is capable of managing the
25 allocation into and the release (de-allocation) from the memory of the various GSM_BTS_RR 54a corresponding to the active GSM users.

Module BTS_RRM 53, as an additional characteristic of the present invention, is capable of implementing the RRM (Radio
30 Resource Management) protocol layer of the BTS.

In particular, module BTS_RRM 53 is capable of managing the allocation of the radio resources to the GSM and GPRS users active at a given instant of the simulation.

According to a first characteristic, module BTS_RRM 35 is
35 such as to allow the simulation of a network in which different systems, like for instance GSM and GPRS, are used.

According to a second characteristic, module BTS_RRM 53, according to the present example of embodiment, has different

implementation forms depending on the technological characteristics of the BTSs.

As is known, the RRM entity is not completely defined through the GSM and GPRS standards; thus the implementation of
5   modules allowing its simulation must take into account the possible technological alternatives, such as the management algorithms of the radio resources according to the specifications of a given BTS manufacturer.

By virtue of the architecture according to the present
10   invention, the technological variability may be managed by using in particular specific BTS_RRM modules 53 and without modifying the characteristics of simulator 30.

Obviously, the specific modules BTS_RRM 53 will give rise to integrated and high performance simulation object modules in
15   terms of simulation times, even if diversified.

The operation of the system described so far is highlighted hereinafter, making reference to the flow chart of Figure 5.

During a first step (scenario definition), a given file
20   of configuration parameters (input data) 35 is loaded on the Work Station 10 (Figures 1, 2, 3, 4, and 5), for instance of text type, representative of the so called simulation scenario.

Input data 35 comprises, for instance: the average number of
25   mobile telephone sets and the number of radio base stations being present during the simulation; references to data banks representative of the territory on which the simulation is to be performed and having corresponding devices which can be configured on the basis of such data banks.

30   In a second step (initialisation) 120, the parameter manager processing module, 31a, after a formal check of input data, 35, carries out the allocation into the memory of Work Station 10 of a number of devices and related object modules forming the devices, on the basis of input data 35.

35   In such a step 120, the devices and related components are initialised through parameters and variables as a function of input data 35, such as attenuation parameters, configuration

parameters, etc, so that the initial scenario of the simulation is determined.

Upon the sequential completion of step 110 and 120, during a third step (simulation) 130, simulation engine 31
5   activates the actual simulation of the network for mobile radio apparatuses.

For instance the simulation 130 comprises:

- activation of the mobile sets allocated into the memory of the Work Station at a rate statistically defined on the basis
10   of input data 35;

- exchange of information or messages between the allocated mobile sets and the devices, for instance of BTS type, involved in the information exchange with the mobile sets;

The simulation 130 goes on by successive steps and,
15   although each operation is carried out by the devices in a sequential way in the CPU of Work Station 10, if unique, each simulation step is obviously managed by simulation engine, 31, and analysed, considering the activity of the devices as a contemporary activity, performed in parallel, as is
20   customary with the simulation tools.

During step 130, against each simulation step, engine 31 activates the event scheduler module 31b, (event scheduling step, 150) so as to schedule the events of information exchange or messages among the devices and/or the devices
25   and/or their components.

Step 150 schedules in terms of time the activity of the network of mobile radio apparatuses on the basis of parameters defined in input data 35 as well as collected during the simulation steps.

30   Furthermore, during step 130, at each simulation step, engine 31 activates, if necessary, the factory manager module, 31 c, (memory optimisation step 160) so as to optimise the allocation and access times to the RAM of Work Station 10.

35   Step 160 takes into account the variations in terms of active devices at each simulation step, and allows for instance keeping allocated, for a defined time, object modules

15

internal to BTS 51, such as the GSM_BTS_RR modules 54a, with
a view to a possible re-use in subsequent steps of step 130.

Eventually, during step 130, against each simulation
step, engine 31 activates the statistic manager module, 31d
5   (data collection step 180) so as to collect from the various
devices involved in the simulation step, data concerning, for
instance,
- number of active users;
- resources assigned in terms of time slots, channels,
10 frequencies;
and to store said detailed data, this being an additional
characteristic of the present invention, for future
quantitative and statistical analyses.

In any case, step 180, through the statistic manager
15 module, 31d, is also capable of compiling, once step 130 has
been completed, and on the basis of data collected during the
various simulation steps, various statistics concerning
values for parameters such as:
- mean values of call delays;
20 - number of handled calls;
- number of blocked calls;
- variance on service mean values;
- confidence or reliability of the mean computed values;
and is capable of generating as output, in the form of output
25 data 37, tables and graphs which can be displayed on display
12 of Work Station 10.
It is evident that modifications or variations to the above
description are possible as far as dimensions, shapes,
materials, components, circuit elements, connections and
30 contacts, or details relating to the circuits lay-outs, to
the execution herein illustrated and to its method of
operation, however without departing from the spirit and
scope of the invention, as defined in the appended claims.

CLAIMS

1. System for simulating the behaviour of a network for
mobile radio apparatuses, comprising
- a Work Station (10), having
    - data input means (15, 19) capable of inserting data
    representative of a network scenario (35)
    - data output means (12, 19) capable of making available
    data representative of results (37) of the simulation of
    said network; and
- a simulation environment (30) associated to said computer
(10) and capable of simulating the behaviour of said network
on the basis of said network scenario (35) and of generating
in output said results (37);
characterised in that said simulation environment (30)
comprises
- first objects (34) representative of devices and/or
physical elements (41, 51) belonging to said network to be
simulated;
- second objects (31) representative of processing modules
(31a, 31b, 31c, 31d) separate from said first objects (34)
and capable of conditioning and activating said first objects
(34) on the basis of said network scenario (35) to simulate
said network.

2. System according to claim 1, characterised in that said
first objects (34) comprise:
- network devices (41a, 41b) corresponding to a plurality of
network typologies for mobile radio apparatuses and/or radio
protocols, capable of being selectively activated by said
second objects (31).

3. System according to claim 1 or 2, characterised in that
said first objects (34) comprise
- technological devices (53) which can be alternatively
implemented in said simulation environment (30) and
corresponding to a plurality of technologies.

4. System according to claim 1, characterised in that said
network scenario (35) comprises:

17

- parameters indicative of the number of devices of said network to be simulated; and/or

- parameters indicative of the traffic quantity of said network to be simulated;

5   - parameters indicative of the type of services of said network to be simulated.

5. System according to claim 1 or 4 characterised in that said

second objects (31) comprise:

10   - an initialisation object (31a) capable of interpreting said network scenario (35) and of initialising said first objects (34) at determined values.

6. System according to claim 1 or 4 characterised in that said second objects (31) comprise

15   - an event scheduler module (31b) capable of activating at determined instants said first objects (34).

7. System according to claim 6, characterised in that said second objects (31) comprise:

- a memory manager module (31c) capable of dynamically

20   storing into said Work Station (10) said first objects (34) co-operating with said event scheduler module (31b).

8. System according to claim 1 or 4 characterised in that said second objects (31) comprise:

- a result generation module (31d) capable of:

25   - collecting information from said first objects (34) during the simulation of said network; and

- generating at the output of said data output means (12, 19) said results (37) on the basis of said information.

9. System according to claim 8, characterised in that said

30   results (37) comprise:

- detailed results corresponding to said information collected

during the simulation; and/ or

- statistical results corresponding to statistical processing

35   operations on said information.

10. Method for simulating the behaviour of a network for mobile radio apparatuses, incorporating the steps of :

18

- inserting at the input (110) of a Work Station (10) a simulation scenario (35) of a network for mobile radio apparatuses;
- simulating (120, 130, 150, 160) the behaviour of said
5   network on the basis of said scenario (35) and through an integrated simulation environment including:
- first objects (34) representative of devices (41, 51) belonging to said network;
- second objects (31) representative of processing modules
10 (31a, 31b, 31c, 31d), separate from said first objects (34) and capable of conditioning and activating said first objects (34) on the basis of said network scenario (35).
11. Method according to claim 10, characterised in that the simulation step (120, 130, 150, 160) comprises the step of:
15 - allocating into the memory of said Work Station (10) network devices (34) corresponding to a plurality of network typologies for mobile radio apparatuses and/or radio protocols (41a, 41b).
12. Method according to claim 10 characterised in that the
20 simulation step (120, 130, 150, 160) comprises the step of:
- initialising (120) said first objects (31a) at initial values determined by said scenario (35).
13. Method according to claim 10, characterised in that the simulation step (120, 130, 150, 160) comprises the step of :
25 - scheduling (150) the activation of said first objects (34) at determined instants;
14. Method according to claim 13 characterised in that the simulation step (120, 130, 150, 160) comprises the step of:
- dynamically allocating (160) into the memory of said Work
30 Station (10) said first objects (34) on the basis of said scheduling step;
15. Method according to claim 10, characterised by the additional step of
- collecting information (180) from said first objects (34)
35 during the simulation of said network; and of
- generating at the output (180) from said Work Station (10) and on the basis of said information, results of the simulation comprising:

- detailed results corresponding to said information and/or
- statistical results corresponding to statistical processes
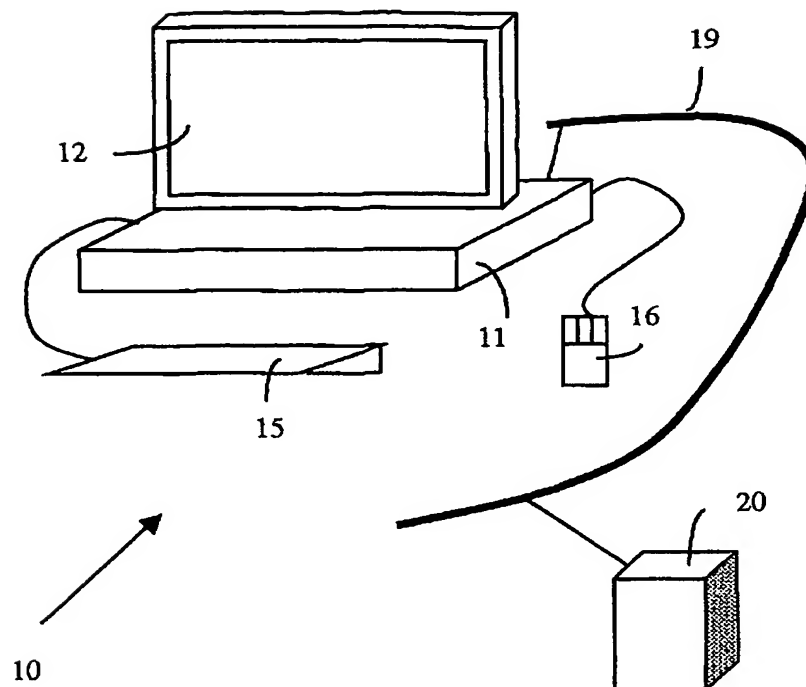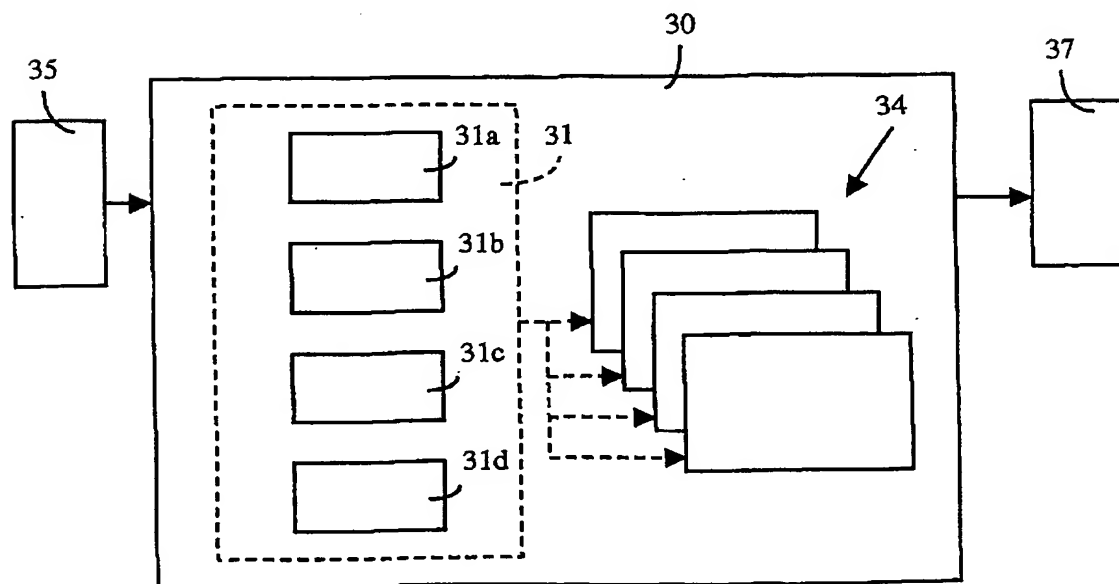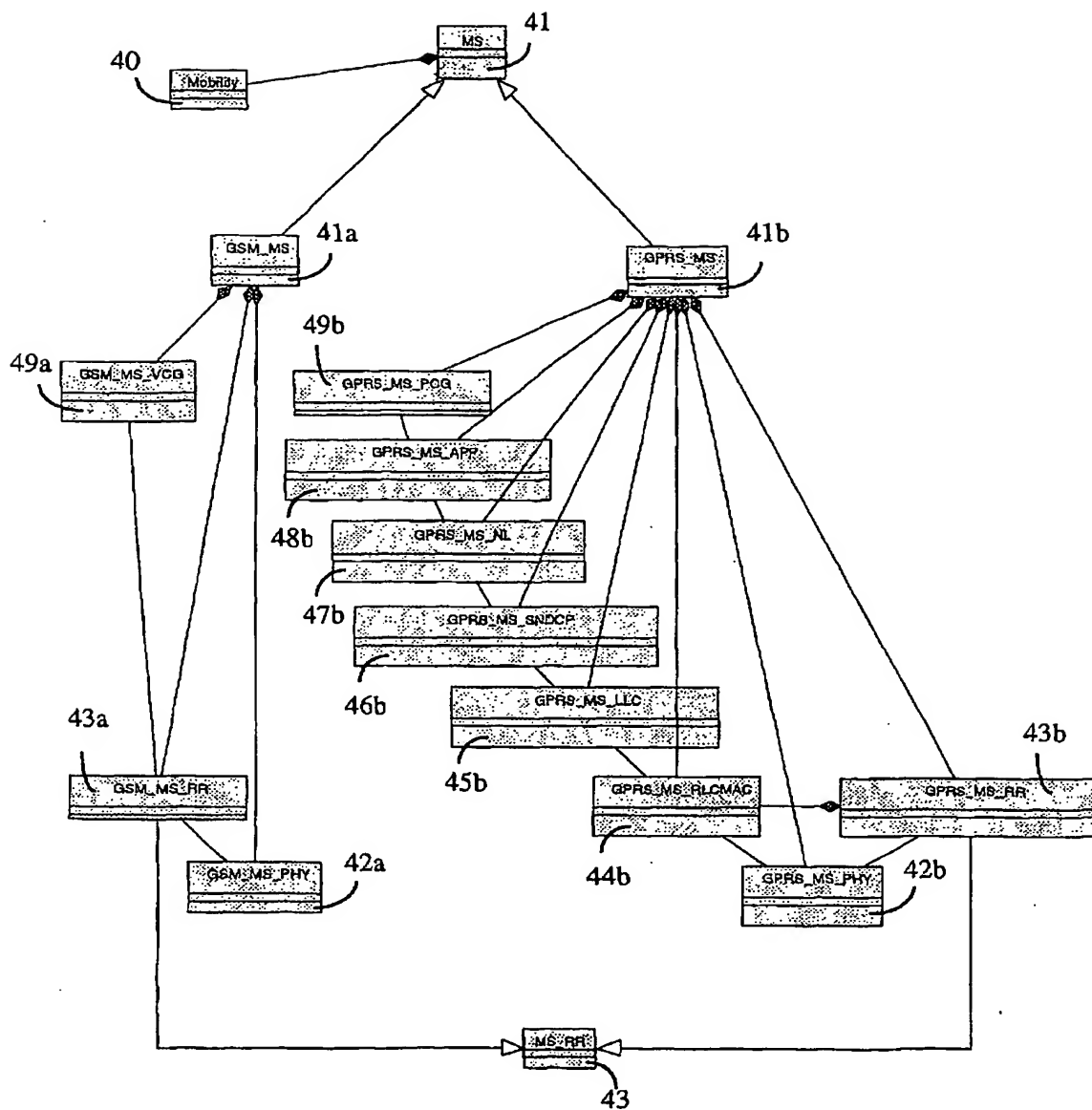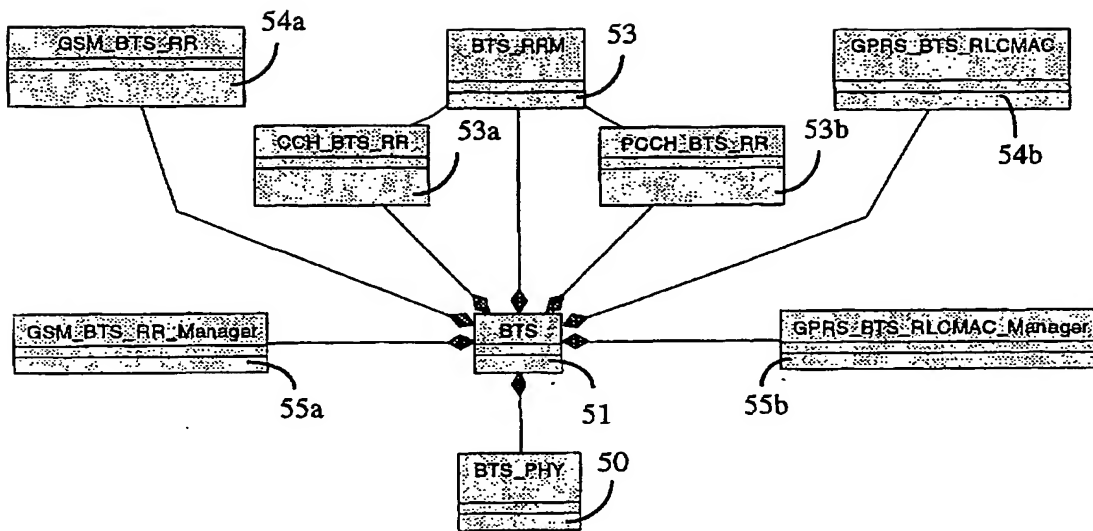carried out on said information.

Fig. 1
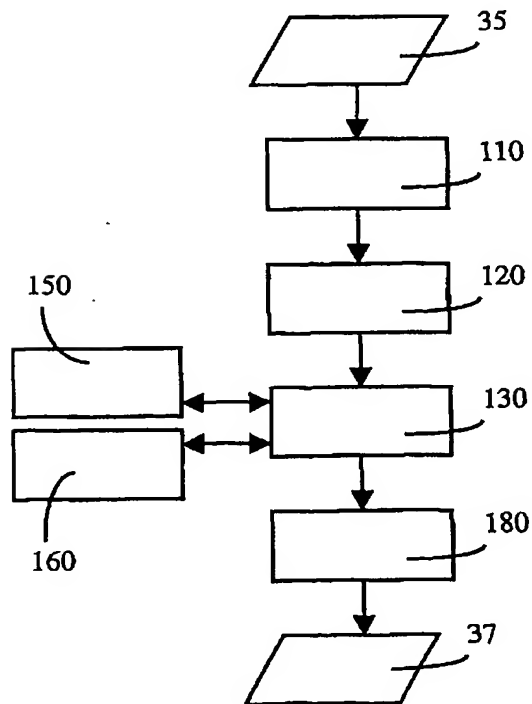

Fig. 2

Fig. 3

Fig. 4

Fig. 5

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IT 02/00385

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   H04Q7/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7   H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

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X	US 5 561 841 A (OTS MARKUS) 1 October 1996 (1996-10-01) column 2, line 8 –column 6, line 62 column 9, line 3 –column 10, line 23 figures 1-3	1-15
X	US 5 809 282 A (COOPER DENNIS ET AL) 15 September 1998 (1998-09-15) column 5, line 33 –column 8, line 45 column 9, line 50 –column 11, line 45 figures 2,7	1-15
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| X | Further documents are listed in the continuation of box C. | | X | Patent family members are listed in annex. |

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Date of the actual completion of the international search	Date of mailing of the international search report
7 October 2002	16/10/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Kreppel, J

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page 1 of 2

Int   tal Application No

PCT/IT 02/00385

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